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PROCESS DEVELOPMENT IMPLEMENTATION PLAN FOR PITS

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OBJECTIVE

The objective of the process development program is to identify, prioritize and develop technologies needed to support both the pit manufacturing mission at Los Alamos as well as the requalification of pits at PANTEX.

BACKGROUND

With the shutdown of the Rocky Flats Plant (RFP), the Department of Energy (DOE) lost the capability to manufacture the pit component of a nuclear warhead. RFP opened in 1952 and at reached its maximum capacity for pit production in the mid 1980s. RFP was shutdown in 1992 with the last pit manufactured in 1989.

With regard to continuing support of the stockpile, DOE has been directed by the President and Congress to:

- Maintain the core intellectual and technical competencies of the United States in nuclear weapons including:
  - Research, design, development, testing, reliability assessment, certification, manufacturing, and surveillance.
  - All three nuclear laboratories and the capability to resume nuclear testing if needed

In order to accomplish the above, DOE has developed its Stockpile Stewardship and Management Program to provide a single highly integrated technical program for maintaining the continued safety and reliability of the nuclear weapons stockpile. This program is described in the Stockpile Stewardship and Management Programmatic Environmental Impact Statement (SSM-PEIS).

In the SSM-PEIS the following assumptions were used:

- Emphasize compliance with applicable laws and regulations and accepted practices regarding industrial and weapons safety, safeguarding the health of workers and the general public, protecting the environment and ensuring the security of nuclear weapons and weapons components
- Analyze alternatives that are consistent with and supportive of, national security policies
- Maximize efficiency and minimize cost and waste consistent with programmatic needs

- Minimize the use of hazardous materials and the number and volume of waste streams consistent with the programmatic needs through active pollution prevention programs and measures.

With DOE's Record of Decision (ROD) for the implementation of the pit manufacturing mission at Los Alamos National Laboratory (LANL) and the pit requalification mission at PANTEX, the complex must reestablish technologies used at RFP or develop new technologies to replace those that are no longer viable.

The process development program supporting these new pit activities started in FY 97 at LANL, Lawrence Livermore National Laboratory (LLNL) and PANTEX. The LANL activities in FY 97 included nitric acid recycle, supercritical carbon dioxide cleaning, ER/MSE processing, analytical chemistry and materials compatibility. These activities were derived by examining the Rev b flow sheets. The Rev b flow sheets originated with the subject matter experts (SMEs) and described the processes needed to manufacture a W88 pit at Los Alamos. The activities selected from LANL were deemed those needing immediate attention. The nitric acid recycle process development was completed in FY97. Installation in PF-4 is ongoing through the use of GPP funds and the process is expected to be operational in FY99. In FY 98, supercritical carbon dioxide cleaning, ER/MSE processing, analytical chemistry and materials compatibility continued and new programs in Pu standards development, development of a metal mold for Pu casting and CO_2 snow cleaning. LLNL started the precision die cast work for the W87 in FY 97 and this is an ongoing project.

PANTEX also started their efforts in FY 97 with the SNM Requalification project that was focused on infrastructure needs, facility needs, and capabilities to meet new requirements. SNM Requalification included sub projects that addressed; 1) the training requirements for limited Pu operations, 2) the input to a facility Conceptual Design Report (CDR) for a year 2000 line item, and 3) the process development of enhancements for existing capabilities or new technologies to meet the new requirements. SNM Requalification at PANTEX for FY 98 has been as continuation of the original effort and has included an increase in scope to address pre-screening, tube replacement and reacceptance. The definition of training requirements has started. Input to the CDR for the facility modification is almost complete and should support a year 2001 line item. Pre-screening requirements have been issued and where applicable existing capabilities are being enhanced to meet these new requirements. New sub-projects for Integrated Pit Inspection, Non-Contact Gauging, and Digital Radiography have been added.

The Process Development Implementation Plan (PDIP) falls under the Advanced Design and Production Technologies (ADaPT) Initiative that provides the means by which the Nuclear Weapons Complex can meet future product realization needs. ADaPT will provide the means to remanufacture weapons while maintaining quality and reliability and preserving capability and capacity needed to support the enduring stockpile in a more efficient manner, The Process Development Program will implement DOE requirements to maintain a viable technology base that is responsive to weapon component production requirements. PDP will assist in the following:

1. Development of processes expected to be used in future production and ensuring these processes are fully production capable.
2. Improvement of current weapon production processes for the regulatory compliance or efficiency, including supporting feasibility demonstration studies for selected processes

The specific objectives of the ADaPT are the following:

• Eliminate design and manufacturing defects in the hardware needed to extend the life of weapons in the enduring stockpile.
• Develop the advanced design and production technologies required to support the Nuclear Weapons Complex (NWC).
• Develop the integrated communications infrastructure required by Design Agencies (DAs) and Production Agencies (PAs) in continued operations of the NWC.
• Develop new materials and processes necessary to enhance the reliability, safety, or security of the nuclear weapons in the enduring stockpile.
• Maintain viable design, development, and production interrelationships among AL, PAs, and DAs.
• Promote more efficient production operations.
• Integrate process development activities required for manufacturing and surveillance testing to support the enduring stockpile.
• Establish and maintain formal teams for the guidance, oversight, and management of PDP activities.

Pit Production Capabilities

Pit production capabilities form the core of the work to be done at the manufacturing facility. Pit manufacturing needs support from all of the following areas:

- Storage, Shipping and Receiving
- Disassembly
- Metal Preparation
- Foundry
- Machining
- Non-nuclear components
- Assembly
- Post Assembly
- Nitrate and chloride recovery
- Liquid waste
- Solid waste
- Analytical chemistry

Each of these areas has a detailed flow sheet associated with it in the Rev B flowsheets as described earlier in this document.

To develop the ability to manufacture pits LANL is going through a three-step process.

The first step is developing the capability through the pit rebuild program. This will allow LANL to capture the capability to fabricate pits in the enduring stockpile. The first steps in this process are taking place in FY 99 with the fabrication of a development unit of the W88.

The second step is developing an enduring capability. This will implement and enduring manufacturing capability of approximately 20 pits per year and will be limited to 1 pit type per year.

The third and final step is limited manufacturing of 50 pits per year with a sprint capacity of 80 pits per year as described in the SSM-PEIS. The limited manufacturing mission will allow for the production of 2 different pit types per year.

The process development program will bring new processes on-line throughout the three steps with its primary focus on the manufacturing mission.

Requalification of Pits

Pit Requalification has been defined as a three-step process.

Step one of this process is a characterization of the component as it exists in the stockpile today. Characterization will begin as an addition to the Weapon Surveillance program. Where applicable, existing capabilities will be used or enhanced as necessary to perform these activities. To complete Pit pre-screening new technologies must be developed and implemented. The data from this characterization effort is vital in supplementing surveillance data and as input to the Stockpile Stewardship weapon modeling activities.

Step two is refurbishment of the component. These activities will be driven by design agency programmatic requirements. The current condition of the component defined in characterization process and the design requirements will define the activity necessary to refurbish the component. Refurbishment can be as minor as re-marking or may include a sub-set of processes similar to those used to manufacture the component.

The final step in Pit Requalification is reacceptance. Reacceptance will employ existing, enhanced and new technologies to verify that the component meets original and new design requirements.

These requalified components will be used to maintain a safe and reliable stockpile through rebuild, weapon refurbishment, and life extension activities.

CRITIERA FOR TECHNICAL TASK PLANS (TTPs)

There are many and varied reasons for technologies to be in the process development program. They are:

- Competence in a technology has been lost because of the time period since the weapons complex has produced a WR pit. This can be due to a loss of personnel and/or certain pieces of equipment are no longer available to support specific processes.
- Processes used at RFP are not amenable to use at LANL, LLNL, and/or PANTEX either due to the configuration of the different production sites and/or the difference in throughputs of the two sites.
- Statements in the SSM-PEIS that all wastes and residues will be recovered and put into an acceptable form. While RFP was in operation large volumes of residues, in some cases metric tons, were generated as the emphasis was on the production of nuclear components. Additionally many of these legacy wastes are categorized as mixed wastes and will require special processing methods to produce a residue or waste that is in an acceptable form for storage and/or disposal.
- Use of certain chemicals and/or equipment is no longer permitted due to regulatory requirements.
- Technologies have been developed at weapons complex sites that are sufficiently mature to warrant consideration in a baseline manufacturing flowsheet. These technologies may be cost effective, minimize waste and/or provide for safer operating parameters.
- Technologies must be developed to comply with federal and state regulations. As an example, the groundwater discharge permit for the radioactive liquid waste treatment facility (RLWTF) at TA-50 limits the amount of nitrate at the discharge point. In the past TA-55 has sent solutions containing nitrates in molar quantities to the RLWTF. TA-50 does not have the processing capability to deal with nitrates (the capability at TA-50 is for solutions on the order of 100ppm) at such a high level when the discharge must be less than 10ppm. To help LANL meet its environmental responsibilities, a nitric acid recycle system is being developed and deployed at TA-55.

The proposed development tasks were prioritized using the following guidelines:

- Is technology sufficiently mature that the probability of success is high and the technology/process will be implemented in time for the startup of the manufacturing mission.
- When is the technology needed to support a specific weapon type?
- Is the technology designed to address a regulatory issue?
- Is the technology cost effective?
- Does the technology reduce waste generation?
- Does the technology provide for a safer work environment?

It should be stressed that the PDIP is a living document. Changes in such things as regulatory issues, DOE guidelines, design agency requirements, etc., will cause the list of needed development activities to change. Also, as the NWC gains knowledge as the pit rebuild program progesses and as the various pit types are built, the priorities and tasks in process development will change.

The following tables reflect the budgets associated with pits.

BUDGET AND SCHEDULES

	LANL		LLNL		Pantex	
	FY 99	FY 00	FY99	FY00	FY99	FY00
Manufacturing	4.5	5.205	1.9	1.9		
Requalification	.575 DisCADM	.650 DisCADM			2.450 PDP	1.040 PDP

Table 1
Budget By Site in $M

TTP	FY 99	FY 00	FY 01
Conceptual Design Report for Pit Requalification Facility	100	100	100
Integrated Inspection Station	300	350	
Non-contact Gauging	1350	450	300
Digital Radiography	700	140	300
Engineering Development for Tube Replacement			500

Table 2
Pit Requalification Budget

TTP	FY 98	FY 99	FY 00
Program Integration	225	125	200
Analytical Chemistry	500	450	500
Pu Standards	275	725	0
Supercritical Carbon Dioxide Cleaning	533	675	400
Metal Mold for Pu casting	275	750	750
ER/MSE Processing	250	305	355
Materials Compatibility	500	600	600
Pu Surface characterization		220	200
B61 Casting		150	0
On-Line metal Spec		250	250
Mechanical Property Validation		250	0
Pu Inspection (Ring Rotocon)			500
Welding			500
Slant Bed & Automated Lathes			300
Vitrification			300
Near Net Shape Beryllium			0
NDA/ Accountablity			350
Density			
Totals		4500	5205

Table 2
Pit Manufacturing LANL Budget

Precision Plutonium Die Casting

Project Basis:

LLNL is developing die casting as an advanced technology for plutonium part production as a substitute for the current gravity casting process. Die casting produces parts in reusable metal dies, replacing the graphite molds that are a large source of waste in the gravity casting process. Die casting also reduces the plutonium requirements and scrap generation by casting closer to the final part size. The finer grain size produced by the rapid cooling with the relatively colder metal dies will allow shorter heat treatment times (homogenization) for the castings. The reduced time requirements for homogenization may also allow this process to be accomplished in the die immediately after casting, thus reducing the part handling and need for separate heat treatment furnaces. The reduced process material inventory and handling will also reduce personnel radiation exposure.

Technical Description:

The proposed development activities will build on several years of experience producing plutonium castings in surface treated metal dies. Development activities to date have demonstrated that the die casting process can produce parts with quality that meets pit specifications. The project will continue prototype engineering of the casting system, metal dies, die heater, and heater insulation jacket designs to enhance the process. In the last development casting runs LLNL processed the casting through trial in-situ homogenization runs that showed good temperature uniformity and easy casting release from the die. Continued development will also include further evaluation of another die casting configuration that has the potential to reduce the amount of starting plutonium required. Die casting has a potential for use in several pit designs. Also plans include the evaluation of precision die casting for other stockpile designs to assess the advantages.

Deliverables:

FY 99	· Final hardware designs and process definition · Characterization of product: microstructure, properties, uniformity, & stability · Demonstration of process & product reproducibility
FY 00 FY 01	· Evaluation of casting system improvement for material efficiency · Evaluation of precision die casting for other pit parts

Cost and Schedule:

Funds	**FY 99**	**FY 00**	**FY 01**
Operating ($k)	1,900	1,900	1,900
Capital ($k)	0	0	0

Analytical Chemistry

Project Basis:

The objective of work is developing the necessary instrumentation, personnel, and analytical chemistry operations to support pit manufacturing. There are several key analytical chemistry initiatives that are required for qualification of plutonium for pit manufacturing (PM). These analytical initiatives are broken down into two categories: (1) instrumentation and analysis, and (3) new and improved analytical techniques.

Technical Description:
Instrumentation and Analysis:

Analysis of gases in the interstices of plutonium metal, such as hydrogen, carbon, nitrogen, oxygen has been required by the design agency for the pit rebuild program. Although this analysis has not been a formal requirement in the past manufacturing program at Rocky Flats Plant, in recent years has been recognized as an important aspect of product quality. This initiative requires procurement of equipment, development of methods and procedures, and integration of the analysis technique with both pit manufacturing and pit surveillance programs.

New and Improved Analytical Techniques:

The Hybrid Densitometer is a combination X-Ray Fluorescence and absorption spectrometer that an provide semi-quantitative to quantitative plutonium and uranium assay measurements. The main advantage is rapid analysis at TA-55 in support of manufacturing.

Micro X-Ray Fluorescence (Micro-XRF) is a technique which can be used to rapidly (<5 days) analyze plutonium metals and alloys and meet anticipated sample turn around requirements of from pit manufacturing. Development of an analysis method is the major part of this work.

Glow Discharge ICP-MS would be used to rapidly monitor the impurities in plutonium metal from electrorefining. The analysis of trace metallic impurities would also provide a semi-quantitative measure of plutonium purity by difference. This technique also provides more rapid analysis of plutonium metal required by the foundry.

Chemometrics is the application of mutlivarient statistical tools to resolve physical and chemical measurement interferences. This results in less upfront sample prep giving quicker turnaround and less waste.

Deliverables:

FY 98	· Hybrid Densitometer technique and Micro XRF for assay and alloy analysis.
FY 99	· Interstitial laboratory for analysis of gases entrained in plutonium metal using combustion techniques. The gases to be analyzed for are carbon, oxygen, and nitrogen entrained in the interstices of the metal.
FY 00	· Glow discharge ICP-MS method for rapid trace element analysis of plutonium metal samples · Chemometrics development complete

Cost and Schedule:

Funds	**FY 99**	**FY 00**	**FY 01**
Operating ($k)	450	500	700
Capital ($k)	0	0	0

Pu Standards

Project Basis:

Presently there is a limited supply of plutonium metal CRM standards available at Los Alamos National Laboratory (LANL) (<40) and at New Brunswick Laboratory (NBL) (<30). Approximately 35-40 Pu CRM standards are used annually at LANL for plutonium analyses. Since these standards are frequently used, it is necessary to redevelop the capability to prepare new plutonium CRM metal standards for testing and qualification of metal used in war reserve (WR) components fabricated by PRP and future Pit Manufacturing unit operations (PMUO's). The last plutonium metal CRM standards were prepared twelve years ago. This time lapse from the last standards preparation has resulted in the loss of much of the technical expertise needed to prepare standards at LANL. Many of the technical personnel who made standards are either retired or are preparing for retirement and this will result in a loss of "corporate memory".

Technical Description:

The project will focus on developing the technologies needed to manufacture plutonium standards as well as documenting the process for future preparations of these standards. The work includes double electrorefining the Pu metal, casting Pu rod for cutting into 1 gram samples and sealing these samples. A new ampule sealing system is being designed and fabricated that meets current TA-55 requirements.

Deliverables:

FY 99	· Develop and implement processes needed to fabricate and certify of 800-1000 plutonium metal standards. · Documentation needed to prepare Pu standards when supplies dictate.

Cost and Schedule:

Funds	FY 99	FY 00	FY 01
Operating ($k)	600	NA	NA
Capital ($k)	0	0	0

Supercritical Carbon Dioxide Cleaning

Project Basis:

Cleaning operations are integral in assembling the pit component. Traditionally this operation has required the use of a chlorocarbon (the use of a chlorocarbon results in the generation of a mixed waste that must be treated prior to disposal) to remove the machining oils. The first step in eliminating the use of chlorinated solvents in the manufacturing use is the development and deployment of supercritical carbon dioxide cleaning as the method for cleaning Pu shells.

Technical Description:

Rocky Flats Plant (RFP) personnel initiated the investigation of cleaning of Pu weapon components in the late 80's. Materials compatibility and cleaning efficiency research was carried out jointly by RFP and Los Alamos and was found to be compatible and very efficient at removing oils from Pu surfaces. Design and fabrication of the cleaning system was begun in 1994 by NMT-5 and was continued in 1996 by CST-12. During FY 97 CST-12 personnel evaluated the cleaning system and several structural and operation deficiencies were discovered. A modified design was proposed and accepted by NMT-8 and NMT-5 personnel and glove box modifications were completed in FY 98. FY 99 will see the cold testing needed to optimize the process with installation in PF-4 to follow. The process is expected to be production ready in FY 00.

Deliverables:

FY 99	· Completion of cold testing and optimization · Hazards analysis submitted to DOE · Installation started in PF-4
FY 00	· Installation complete in PF-4 · Operational Readiness Review and Readiness Assessment complete · System transferred to operations group

Cost and Schedule:

Funds	**FY 99**	**FY 00**	**FY00**
Operating ($k)	674	400	NA
Capital ($k)	0	0	NA

Metal Mold for Pu Casting

Project Basis:

Develop and implement a reusable metal mold for plutonium shape casting. The current graphite molds require frequent replacement and represent significant contribution to TRU waste and involve subsequent down-stream recovery processing. A long-lasting mold will drastically reduce TRU waste volumes and provide advantages in the areas of in-house residue processing.

Technical Description:

Currently, Pu casting into shapes employs coated graphite molds. The current graphite molds for WR part production are serviceable 2 to 4 times before they are sent to residue recovery. Waste minimization is a continuing issue in future pit production plans, and graphite waste will become a growing problem as production is brought on line. A reusable metal mold is a solution to eliminate future graphite waste. NMT-5 has shown that a very long life metal mold is definitely possible. Over the last 50 years, NMT-5 and other weapons complex sites have used Ta crucibles and Ta split rod molds during Pu chill casting. The Ta used as a construction material for this application has performed for well over 1,00 service usages. In addition, refractory Ta-based construction materials have been proven impervious to liquid Pu corrosion. The project focuses on the design and engineering features to incorporate a robust construction material into the shape casting operation and does not rely on any unproven technologies.

Deliverables:

FY 99	· Spin forming machine operational · 3 simplified metal molds fabricated using Ta · Testing and evaluation of simplified molds complete · Determination if Ta-Nb alloys are suitable materials of construction for metal mold
FY 00	· Fabricate production scale mold · Testing and evaluation of mold complete

Cost and Schedule:

Funds	**FY 99**	**FY 00**	**FY 01**
Operating ($k)	750	750	NA
Capital ($k)	0	0	0

ER/MSE

Project Basis:

Pyrochemical processing is an integral part of the flowsheet for pit manufacturing. These processes include electrorefining (ER), molten salt extraction (MSE), multicycle direct oxide reduction (MCDOR), and salt distillation. ER, MSE, and MCDOR are fairly mature technologies; however, the ER and MSE processes generate waste and/or have exposure problems associated with them. With waste minimization and radiation exposure being drivers for process development work, the processes can benefit from improvements that directly affect these parameters. ER generates large quantities of plutonium-bearing residues that must be recovered using aqueous chloride processing. MSE, while 99% efficient, separates the americium from the plutonium and therefore has exposure problems associated with it.

Technical Description:

Pyrochemical processing is needed for the metal preparation area of the manufacturing flowsheet. The processes include electrorefining (ER), molten salt extraction (MSE), multiple cycle direct oxide reduction (MCDOR), and salt distillation. Although ER, MSE, and MCDOR are fairly mature technologies TA-55 has needed to revive these capabilities. Additionallt these processes generate a significant amount of waste and/or have exposure problems associated with them. One example is ER, which generates large quantities of plutonium bearing residues that are currently recovered via aqueous chloride processing. Another example is MSE, which currently exhibits exposure problems when separating the americium salts from plutonium metal. By incorporating upgrades such as programmable furnace controllers and demonstrating new technologies such as salt distillation in these processes, LANL will see greater efficiencies while reducing wastes and radiation exposure.

Deliverables:

FY 99	· Programmable Logic Controller (PLC) installed and operational on furnace. · PLC based ER controller installed and operational · Determination if split cell ER is applicable at production scale
FY 00 FY 01	· Furnace controllers upgraded and integrated into a centralized control/monitoring system · Document ER product purity and correlate with processing parameters to improve overall process efficiency and product purity

Cost and Schedule:

Funds	FY 99	FY 00
Operating ($k)	305	400
Capital ($k)	0	0

Materials Compatibility

Project Basis:

The objective of this work is to develop a process material laboratory for testing and assessment of materials used in pit manufacturing operations and qualify the supplies needed for manufacturing.

Materials compatibility is required for both the nuclear non-nuclear components needed to fabricate a pit. This will be necessary for process materials used with plutonium components and, aAlthough Los Alamos has an inventory of non-nuclear components, it will be essential to evaluate and test process materials that will come into physical contact with non-nuclear components. Analysis and testing of new process materials with nuclear and non-nuclear components will be required for WR approval and certification.

Technical Description:

A process materials testing laboratory will be put in place TA-35 and the proper documentation will be developed. Process materials will be chemically evaluated for their compatibility with pit manufacturing components as well. Testing of plutonium components or coupon studies will be conducted at TA-55. Also, this laboratory will be used to assess solvents used for cleaning components used in pit manufacturing

Review the materials compatibility program used at Rocky Flats Plant and approval of materials at Los Alamos will be conducted through the Process Materials Review Committee. Evaluation of the open literature and industry for commercial products which can be used in pit manufacturing, will be included in the review.

Deliverables:

FY 99 FY 00 FY 01	· Certification processes needed for selection of a solvent for cleaning plutonium hemi-shells and pits · Development and set-up of a process materials testing laboratory · Formalized approach to evaluation and testing of process materials used in WR operations

Cost and Schedule:

Funds	FY 99	FY 00	FY 01
Operating ($k)	600	800	800
Capital ($k)	0	0	0

B61 Casting

Project Basis:

The B 61 pit component was previously produced at RFP using the wrought process. LANL has previously cast the plutonium component of the B 61, however more than 15 years have lapsed since the previous casting. This task will ensure that the B61 Pu component can be cast as well as optimize the process.

Technical Description:

The poject will use conventional casting techniques and equipment at LANL to ensure LANL's ability to cast components for the B 61.

Deliverables:

FY 99	· Demonstrate that weapons grade Pu components for the B 61 can be fabricated using the cast to shape process.

Cost and Schedule:

Funds	FY 99	FY 00	FY 01
Operating ($k)	150	200	NA
Capital ($k)	0	0	0

Pu Surface Characterization

Project Basis:

Develop experimental system and methodology to perform rapid and non-invasive Pu oxide film characterization on PRP parts for the ultimate purpose of process monitoring and quality assurance. The thickness and compositional gradients (layering) of the films will be determined by reflectometry. This methodology will be compatible with applicable TA-55 experimental and process activities including inert glove box operations.

Technical Description:

The ideal way to make these measurements is to perform non-invasive evaluations directly in the glove box environment without cutting or defacing the components. The measurement tool is a reflectometer with a fiber optic probe and an appropriate fiber optic interface into a glove box. This probe consists of a reflectance sampling head with specifically designed standoff devices for interrogation of concave and convex surfaces. Measurements will be made in the visible region of the spectrum from 350 to 850 nm. These measurements are simple and fast, furthermore the use of fiber optic coupled probes allows versatile and rapid interrogation of any point of the surface of the sample.

Deliverables:

FY 99	· Ellipsometer testing complete
FY 00	· Reflectometer will be installed and operational with the calibration data need to characterize various plutonium oxide films

Cost and Schedule:

Funds	**FY 99**	**FY 00**	**FY 01**
Operating ($k)	220	200	NA
Capital ($k)	0	0	0

On-line Metal Spec

Project Basis:

Prior to transferring "good" metal from the metal prep area to the foundry it must be certified as pure by analytical techniques or the metal must be used "at risk". Traditionally the metal has been removed from the process line and transferred to the vault while awaiting the analysis. With an on-line techniques to determine if the metal meets the plutonium specification, it can then be transferred directly to the foundry without all of the in between steps. This will reduce worker exposure and time as well as reduce the amount of waste generated in the facility.

Technical Description:

Glow Discharge Mass Spectrometry (GDMS) is a rapid, direct technique for the quantitative elemental analysis of solids. The glow discharge (GD) ion source consists of 2 electrodes in a militorrs of Ar atmosphere. A potential (ca. 1 kV) applied to the sample (which acts as the cathode) produces an Ar plasma. The Ar ions bombard the sample surface and sputter sample atoms, which then diffuse into the self-sustaining negative glow where they are ionized. The most important property of the GD source is that sample atoms are ionized following sputter atomization. Since atomization and ionization occur in two discrete steps, GDMS is relatively free of matrix bias. Ions produced in the negative glow can either be sampled into a mass analysis system (time-of-flight, quadrupole, magnetic sector), or analyzed spectroscopically.

Metals and other electrically conductive materials require minimal preparation other than cutting to a size and shape appropriate for the GDMS source. During GDMS analysis, only a very small amount of material is sputtered and mass-analyzed: for steel samples, several hours of analysis leaves a cylindrical crater 1 to 3 mm in diameter(< 0.1 mm deep). Analysis by GDMS provides complete coverage of the periodic table, including many elements that are difficult to quantitate by other methods. A quadrupole-based GDMS would provide detection limits that are more than sufficient for TA-55 analytical needs. The wide dynamic range of the detection system would permit quantitation from weight % to ppm in a single analytical run.

Deliverables:

FY 99 FY 00	· Develop, design, build, test and implement a small quadrupole-based GDMS system for Pu metal analysis in TA-55. Our design will emphasize easily obtainable and replaceable parts and materials, mechanical simplicity and robustness, easy-to-handle components (i.e., within a glovebox), and minimal maintenance.

Cost and Schedule:

Funds	**FY 99**	**FY 00**	**FY 01**
Operating ($k)	250	250	NA
Capital ($k)	0	0	0

Validation of Mechanical Behavior

Project Basis:

There are many advantages to using reusable dies in manufacturing casting operations. However, the properties of the material produced by such techniques must have a baseline developed. This project will accomplish that. The proposed program is just beginning. We anticipate a project start date of October 1, 1998. This project will support the casting infrastructure and process development for metal molds and the B61. If successful we will dramatically enhance manufacturing competency. In addition, this project will enhance the Los Alamos capability to measure the mechanical behavior of Pu and its alloys.

Technical Description:

1. Tensile specimen designs will be prepared in concert with die designs for making test specimens. We need to be concerned with specimen sizes, shapes and matching die properties, for example cooling rates, with what we expect to see in die performance from pit production. Tensile testing fixtures and the test procedures will be designed, evaluated and fixtures produced. Data acquisition and analysis software will be written and archived. Simulation experiments, including data acquisition and reduction will be run to develop test expertise.Tensile specimens of Pu and its alloys will be cast and inspected. Pu tensile experiments will be conducted and results analyzed. Feedback will be provided to the manufacturing unit.

Deliverables:

FY 99 FY 00	Measurement of the mechanical behavior of Pu material cast in metal dies. The properties that we measure: yield strength, ultimate tensile strength, elongation and total elongation will reflect the casting conditions. The results of these measurements will be used to evaluate the casting processes.

Cost and Schedule:

Funds	FY 99	FY 00	FY 01
Operating ($k)	250	250	NA
Capital ($k)	0	0	0

Program Integration

Project Basis:

Through the pit manufacturing technology process development program, personnel at Los Alamos will develop and deploy processes/technologies needed to support the pit manufacturing mission. A list of key technologies that need development work was derived as part of the pit manufacturing activity implementation plan (PM-AIP) and was further refined after careful evaluation of the pit manufacturing flow sheets. Requirements for implementation of these technologies are based on such things as adapting and changing R&D processes to production operations within the constraints of a different facility, regulatory compliance, reducing costs, minimizing wastes, and safety. As processes are altered, changes must be approved by the design agency, whether Los Alamos or Lawrence Livermore; this task will serve as an interface to the design agency.

Technical Description:

Process development activities must be coordinated, prioritized, and integrated in view of the limited resources in personnel, space, and funding. This task will also serve as the interface for development activities to the Pit Manufacturing Integrated Plan

Deliverables:

FY 99 FY 00	· Pit Manufacturing and Development Plan · Continued flowsheet/proposal evaluation · Reassess task list, priorities and incorporate new proposals as needed · Quarterly and final reports · Production ready processes

Cost and Schedule:

Funds	FY 99	FY 00	FY 01
Operating ($k)	200	200	200
Capital ($k)	0	0	0

TTPs for Pit Requalification

Conceptual Design Report for Pit Requalification Facility

Project Basis:

The objective of this work is to provide technical input to the Mason & Hanger Facilities Design group for incorporation into the Conceptual Design Report (CDR) for Pit Requalification Facility. This CDR will be presented to DOE as the basis for modification of a facility that will consolidate and add new capabilities required for pit requalification. This facility modification is required to provide operational space with the correct safety authorization basis to consolidate existing nuclear material operations and add the new capabilities.

Technical Description:

This sub-project will detail the capabilities required, the processes and their associated hazards, and provide information about the time frames when these activities must be operational. To provide this input a periodic review of requirements will be completed. Applicable existing capabilities will be identified. New technologies will be defined to the extent required for incorporation to the design for the facility modification. General process flows will be established also to facilitate the design for the facility modification.

In addition to the new technologies and processes, the process hazards and waste management activities must be defined. These individual activities will be used as input to the process hazards assessment and NEPA documentation for the facility modification project.

Deliverables:

FY 99 FY 00 FY 01	· Establish matrix of existing capabilities versus requirements · Define capabilities required to be located in new facility · Provide support for validation of the CDR · Provide support for Title 1 and 2 facility design · Coordinate implementation of new technologies with facility modification

Cost and Schedule:

Funds	FY 99	FY 00	FY 01
Operating ($k)	100	100	100
Capital ($k)	0	0	0

Integrated Pit Inspection Station

Project Basis:

When pits were built at RFP many of the design requirements were satisfied by the execution of a qualified process. These pits have been in various stockpile weapon systems for more than 25 years. Requalification must validate that the original design requirements are still being met.

Technical Description:

This sub-project will develop the processes and implement an Integrated Pit Inspection Station for the evaluation of pits at PANTEX. The Integrated Pit Inspection Station has been developed by LANL. The inspection station will facilitate enhanced Ultrasonic and Eddy Current techniques, and Acoustic Resonance Spectroscopy.

Deliverables:

	· Define technical capability and configuration of station
	· Procure components and begin process development
FY 99	· Install station in non-nuclear area and complete process development
FY00	· Transition station to full operations for surveillance of pits

Cost and Schedule:

Funds	FY 99	FY 00	FY 01
Operating ($k)	300	350	NA
Capital ($k)	350	100	0

Non-Contact Gauging

Project Basis:

The design requirements for pits built at RFP included high accuracy gauging of the components. The assembly of these components was performed using a qualified process. Final gauging of the pit was often a few single point measurements to establish the pole height and diameter. These pits were then assembled into various stockpile weapon systems and have been in stockpile for more than 25 years. This project is to define and develop a system and methodology to perform rapid, high accuracy and non-invasive process for the ultimate purpose of gauging the pit exteriors. Requalification will then employ this system to validate that the original design requirements are still being met.

Technical Description:

An optical gauging technology has been demonstrated and is being implemented at PANTEX to perform gauging for the reacceptance of case parts. This system does not have accuracy required to gauge pits at this time. A continuation of this project is being supported by LANL to determine if the high accuracy capability can be achieved. If this technique can produce the required accuracy, the necessary enhancements will be made and the system will be implemented to reaccept pits.

In addition to the optical gauging discussed above LASER Holography, using different detectors is being evaluated to determine if the required accuracies can be achieved.

The end result for any of the technologies being evaluated is to produce data that can be reconstructed into a 3D image of the component. This 3D image will then be imported into the CAD file for comparison against the design requirements.

Deliverables:

	· Procure system for gauging case parts
FY 99	· Install station in non-nuclear area and complete process development
FY 00	· Determine if system can be enhanced to improve accuracy
FY 01	· Enhance system as required and transition it to nuclear area for gauging pits

Cost and Schedule:

Funds	**FY 99**	**FY 00**	**FY 01**
Operating ($k)	1350	450	300
Capital ($k)	150	100	0

Digital Radiography

Project Basis:

Film radiography has always been a vital tool in the evaluation of pits. The disadvantage of this film radiography is that a limited number of images can be captured. Employing digital radiography offers several advantages. The waste streams associated with film processing are eliminated. Multiple images can be captured quickly. These images can be stored in formats that are consistent across the NWC. The digital images can be reconstructed and be reviewed as 3D images of the pit. Requalification will then employ these 3D images to validate that the design requirements are being met.

Technical Description:

New amorphous Si detectors have become available that have comparable resolution to film. Pantex and LANL are jointly working to evaluate the feasibility of using these digital detectors as replacement for film in the existing X-Ray systems. The new detectors will be procured along with the electronic control and computer systems. The new technology will be implemented so that a process can be developed on nuclear like components. The capability of digital radiography with CT type reconstruction will have to be proven equal to or better than film. If the digital radiography process can be implemented the NWC requirements for film radiography will be changed to allow digital radiography as an additional method to film and the process will be implemented in a nuclear facility to evaluate pits.

Deliverables:

FY 99	· Procure systems to use for process development at PANTEX
FY 00	· Install station in non-nuclear area and complete process development
	· Determine if system is equivalent to film
FY 01	· Transition system to nuclear area for radiography of pits

Cost and Schedule:

Funds	**FY 99**	**FY 00**	**FY 01**
Operating ($k)	700	140	300
Capital ($k)	150	150	500

Engineering Development for Tube Replacement

Project Basis:

During the assembly and disassembly, processes associated with weapon build and surveillance the pit tubes are bent to very specific configurations. These tubes work harden during the bending process. This work hardening will eventually result in a failure during the assembly process. To avoid the potential failure during the assembly process tubes that have been bent two or more times should be replaced. Since there has been no tracking mechanism to identify how many times a pit tube has been bent, LANL is supporting a conservative position to replace tubes as a part of requalification.

Technical Description:

Tube replacement is a capability that was utilized at Rocky Flatts. A similar capability is being supported as a part of the Pit Rebuild program at LANL. Subordinate processes that go along with tube replacement include pressure proof testing, an elevated temperature evacuation (bake out), and a backfill with certification of pressure.

All LANL pits that are a part of the enduring stockpile have a design feature that supports tube replacement. An engineering study must be completed to determine if less than all pits will require tube replacement. The existing process must be evaluated to determine if changes to the tube replacement or subordinate processes are necessary. Lastly the process as it will be implemented at Pantex will be developed and qualified.

Deliverables:

FY 01	· Determine if tube hardness can be measured in non-destructive mode · Develop process flow for tube replacement at Pantex

Cost and Schedule:

Funds	FY 99	FY 00	FY 01
Operating ($k)			500
Capital ($k)			250